OBSERVATIONS OF SATURN AT THE DISAPPEARANCE OF THE RING.—In a memoir "Sur la variabilité des anneaux de Saturne," published in the *Bulletin Astronomique* (vol. ii. p. 28), M. E. L. Trouvelot touches on some interesting phenomena that he observed in 1877–78, before, during, and after the passage of the sun and earth across the plane of Saturn's rings. On May 18, 1877, M. Trouvelot remarked that the illuminated surface of the ring appeared notably less luminous than the planet; further observations confirmed this, and left no doubt that its relative light diminished up to the passage of the sun across its plane. It was also observed that the colour of the light of the ring appeared yellowish and slightly orange when compared with that of the planet, whereas observations made between 1872–76 indicated that the planet was of a yellowish colour when compared with the ring. The two sets of observations are thus diametrically opposed to each other; and it appears that, when the height of the sun above the plane of the ring is reduced to 4° 30′, the surface of the latter gradually diminishes in light with the approach of the sun to the plane, and afterwards the opposite surface increases in light intensity until the angular distance of the sun from the plane of the ring is again 4° 30′. The cause of this diminution and increase is not well known. It may be due to the change in the angle of incidence of the sun's rays, and, therefore, in the amount of light reflected or to the absorption of the sun's rays by the atmosphere belonging to the rings, or to many other causes.

From October 6, 1877, when the sun was 1° 49′ north of the plane of the rings, to February 6, 1878, when the sun crossed the plane, the illuminated surface gradually decreased in width until it appeared as a thin line difficult to recognize, because of its extreme tenuity. It was observed that the decrease in the width of the illuminated ring appeared to be produced by a shadow slowly obscuring it, and M. Trouvelot attributes the shadow to the existence of a zone elevated above the general level of the ring and slightly inclined towards the planet. To produce the observed phenomenon, a protuberant zone on the ring B, and 6000 kilometres from its outer edge, would have to have an elevation of about 400 kilometres above the plane of the rings: that is, if the north and south surfaces are symmetrical, the thickness of the zone would be 800 kilometres. In consequence, however, of the position of the zone on the ring B, and 25,600 kilometres from the edge of A, the better half of it is generally invisible, hence in practice the thickness may be said to be 400 kilometres, or nearly 249 miles.

Prof. A. Hall has a short note on "The Thickness of Saturn's Ring," in the *Astronomical Journal*, No. 222, and develops the equation by means of which it may be determined. He also notes that Dusejour gives a value equivalent to 958 English miles in his "Traité Analytique," t. ii. p. 127 (Paris, 1789), as the result of a discussion of the disappearances and reappearances of the ring observed before 1789. Herschel, by comparing the thickness of the ring with the apparent diameters of the satellites, found the value 856 miles (Phil. Trans., vol. lxxx. pp. 6 and 7, 1790).

Schroeter found the value of 539 English miles from measurements of the width of the trace of the ring on the ball of the planet ("Kronographische Fragmente," pp. 157 and 211, Göttingen, 1808).

W. C. and G. P. Bond by comparing the amount of light received from the surface of the ring a short time before its disappearance with the light received from *the edge of the ring* found the value <43 miles.

With respect to this latter value M. Trouvelot remarks: "Mais Bond, qui ignorait que le système des anneaux de Saturne n'est pas plan, et que c'est à une assez grand distance de son bord extérieur qu'il atteint son maximum d'épaisseur, ne pouvait arriver qu'à une évaluation erronée et trop petite de cette épaisseur."

Several other points are touched upon in M. Trouvelot's memoir, viz. that Cassini's division appeared more visible on the eastern side of the planet than on the western, when the elevation of the sun above the plane of the ring was between +0° 45′ and +0° 27′; and that the edge of Saturn, like that of Jupiter, was notably more luminous than other parts of the globe. The difference in outline between the preceding and following parts of the ring, the deformation of the limb of the planet at different dates, and many observations possible during the disappearance of the ring are also considered.

The memoir concludes with some remarks and suggestions on the observations that should be made during 1891–92. The next disappearance of the ring is on September 22, 1891, and it will reappear on October 30 of the same year. Again, in May 1892, Saturn will be well situated for observations on the structure of the rings causing the shadow noticed in 1877–78. It is to be hoped therefore that the increased powers now at our disposal will enable many of the questions raised by M. Trouvelot to be definitely settled.

OBJECTS HAVING PECULIAR SPECTRA.—In *Astronomische Nachrichten*, No. 2986, Prof. E. C. Pickering, Director of Harvard College Observatory, notes that an examination of photographs taken during March and April 1890, by Mr. S. J. Bailey, near Closica, Peru, has led to the discovery of some interesting spectra.

A photograph of the spectrum of R Carinæ (R.A. 9h. 29·7m., Decl. – 62° 21′, 1900) taken on April 4, 1890, shows that the G and *h* lines due to hydrogen are bright, as in Mira Ceti and other variables of long period.

Two photographs taken on March 19 and 20, 1890, of the star, Cordova General Catalogue, No. 15,177, magnitude 8½ (R.A. 11h. 0·8m., Decl. – 65° 1′, 1900), show that it has a spectrum consisting mainly of bright lines, and similar to that of Wolf and Rayet's three stars in Cygnus.

The nebula, General Catalogue, No. 2581 (R.A. 11h. 45·1m., Decl. – 56° 29′, 1900) has the same spectrum as General Catalogue 4628. Both these objects show bright lines in the ultra-violet portion of their spectra, which have not been discovered in any other planetary nebulæ.

D.M. + 30° 3699, magnitude 9·3 (R.A. 19h. 31·9m., Decl. + 30° 19′, 1900), is seen to have bright lines in its spectrum on photographs taken at Cambridge with the 8-inch Draper telescope on June 18, 23, and 25, 1890. The spectrum of this star differs from that of other bright-line spectra of which photographs have been obtained.

ON THE CAPTURE OF YOUNG (IMMATURE) FISHES, AND WHAT CONSTITUTES AN IMMATURE FISH.

SINCE steam-trawling became prominent, frequent complaints of the constant and great destruction of very young fishes by this mode of fishing have been made; indeed, besides the injury to the so-called eggs of food-fishes—then said to be deposited on the bottom—no subject attracted more attention in the Royal Commission of 1883–84—presided over by Lord Dalhousie. Recently the subject has again been urged before the National Sea Fisheries Protection Association—especially by the fish-merchants of London (on the alleged grounds of the diminution in size of the valuable food-fishes)—and, with the assistance of the Board of Trade, an International Conference, to discuss remedial measures "to be taken for the preservation and development of the fisheries in the extra-territorial waters of Europe," was convened in the Fishmongers' Hall. It would be a misapprehension, however, to suppose that those who attended the Conference confined their attention to extra-territorial waters, since the inshore ground (within the three-mile limit) is really more important, *e.g.* in regard to the preservation of certain flat fishes, than the offshore. Thus, as formerly shown, the plaice for the most part passes its early life in the shallow sandy bays of the inshore, and as it attains a length of about fifteen inches it in most cases frequents the deeper water offshore, where it chiefly spawns, the pelagic ova and larvæ being carried shorewards to repeat the process. In the same way multitudes of small turbot, brill, and soles pass their early existence not far from low-water mark on sandy beaches; ling in the barred condition amongst rocks at extreme low-water; and cod, coal-fish, pollack, and whiting, near the same regions. Remedial measures therefore, applied, for instance, to the plaice in extra-territorial waters, could only affect the adult or nearly adult fishes, and mainly in regard to the spawning individuals, a point no doubt of vital importance, but which nevertheless does not touch the question before us, viz. the young or immature fishes.

In most modes of fishing as at present followed, young or immature fishes are captured. Thus, in line-fishing a considerable number are hooked throughout the year, and in certain parts of the east coast many in September and October. When we consider the large number of men engaged in line-fishing, and the almost constant nature of such captures, we cannot conscientiously overlook it. The drain on the young cod, haddock, whiting, ling, and other fishes is a steady one, and though many are replaced in the sea by the fishermen it is doubtful if they will survive. The smaller of the first three, indeed, are generally dead when brought on board. The use of the hook, on the other hand, for the capture of flat fishes—more particularly plaice in sandy bays—contrasts favourably with the work of sailing trawlers on the same ground, since a larger size of fish on the whole is secured; though scarcely a single fish thus obtained is mature. It is probable that the smaller mouth of the pleuronectids prevents the younger forms from so readily taking the hook, the size of which, moreover, would appear to be related to that of the young fishes captured. The liners themselves as a rule apply the remedy, since they leave the ground frequented by small fishes, *e.g.* haddocks, and seek more mature forms. They appear to be aware that these young fishes haunt the same area a considerable time. This practice cannot be too much commended

Beam-trawling and otter-trawling, again, are credited with the capture of many young (immature) fishes. In the case of the beam-trawl, now so extensively used, if the meshes of the net be small and work carried on inshore, or where multitudes of young fishes are, large numbers especially of flat fishes are taken. In ordinary steam-trawling for profit, as observed off the east coast in 1884, however, the actual captures of small (immature) fishes were not as a rule serious. For the most part they consisted of common and long rough dabs, neither of which when adult is a large fish, though both, besides other uses, form an important item in the diet of the more valuable fishes. Off Girdleness (Aberdeenshire), however, a considerable number of young cod were captured in autumn, yet every one of these was used as food and was saleable. In the open offshore water very few young plaice are procured, almost all being of considerable size; but in inshore water, *e.g.* in such bays as St. Andrews, vast numbers of small plaice may be captured with a naturalist's trawl (*i.e.* one with a small mesh), and considerable numbers with the ordinary trawl of either sailing or steam trawler, one of the latter in 1884 having about sixty boxes as its catch. Though the very young plaice are abundant at the tidal margin, yet no graduated lines, indicating an increase in size as we proceed outwards, seem to occur, very small forms being found in the outer lines of St. Andrews Bay as well as those approaching low-water mark.[1]

In steam-trawling for profit, the condition of the captured young fishes depends on the length of time the trawl has been down, the state of the sea, and the condition of the bottom. Thus, if the trawl has been at work for five hours the younger fishes are often dead, and, if not, would probably die if replaced in the water, whereas when the trawl of a sailing boat has been down only an hour the majority would probably live if returned to the sea. If the sea be rough, the pitching of the vessel in hauling causes the bag of the net and its load of fishes to strike the side of the ship, and thus the snouts of the fishes are broken and many killed. In the same way soft muddy ground is fatal to the fishes in the trawl, just as in a less degree, the soft sand of the beach proves destructive to trout swept down by a spate.

Shrimp-trawling is another method of fishing proportionally more destructive to young fishes than perhaps any other. As carried on, for instance, in the estuary of the Thames by sailing boats near Canvey Island and towards Tilbury Fort, multitudes of small soles, dabs, plaice, bib, whiting, and other forms, *e.g.* unctuous suckers and *Cotti*, are retained by the small-meshed net, and before the sifting of the shrimps is concluded the majority have succumbed. Nor are hand-nets and the larger ones drawn by horses less destructive. All cause a frequent and great drain on the young fishes, especially in some places on such valuable forms as soles, turbot, and brill, while the food procured for the public is small in comparison with the loss of fish-food. There should be no insuperable obstacle to the immediate substitution of these methods by others less wasteful to fish-life. The French shrimp-trap, for instance, as recommended by Prof. Giard and M. Roussin, is a step in the right direction.

The use of the "sweep-net" on sandy shores for procuring sand-eels is followed by the capture of numerous young cod, green cod, gurnards, whiting, trout, turbot, brill, dabs, plaice, flounders, and other forms. The net has wings of 4-inch mesh, and a centre of strong netted curtain-gauze, so that small fishes are secured in hundreds. The net is worked by two men, one in a boat, the other on shore, and is especially destructive in estuaries. The little fishes thus captured escape the trawls of both sailing and steam-vessels.

The salmon-stake nets, on sandy beaches, secure many small turbot and brill from 5½ inches upwards.

The stow or bag-net for sprats, as used by yawls in estuaries of rivers, is a small-meshed net of great length, fixed to the side of the vessel by the upper beam, and into which immense numbers of young herrings and sprats, and sometimes many sparlings, are swept by the current, besides various round food-fishes, flat fishes, and unsaleable forms, such as *Cotti*, Montagu's suckers, and pipe-fishes, not to allude to an occasional salmon. The captured fishes are now and then used for manure, and much valuable food is thus lost to the community.

The small-meshed sprat-nets (pole-nets) of the Forth are also responsible for great captures of small herrings and sprats for manure, as well as for the destruction of young round fishes, such as cod and whiting. The capture of whitebait in the Thames is another instance of the wholesale destruction of very young fishes.

From the foregoing brief sketch it will be apparent that no special kind of fishing is responsible for the capture of small (immature) fishes, and that legislative measures, to be effectual, must, more or less, cover all. The question, therefore, is beset with difficulties. The prohibition of the landing and sale of such fishes would, of course, shut them out of the market, but it would not prevent their being captured; and while they might be returned to the water as soon as practicable, the mortality, as already indicated, would be considerable. It is difficult to see how, by any modification of apparatus, these small fishes would be enabled to escape capture by liners, trawlers, shrimpers, seine, and other net-fishermen. As recommended to the Trawling Commission of 1884, the mesh of the trawl-net might be enlarged. Thus, for 9 feet at the cod-end, it might have a 2-inch mesh; then, for 12 feet, 2½-inch mesh; next, 3 and 3½-inch mesh; and, finally, a 5-inch mesh towards the beam. The enlargement of the mesh will not altogether prevent the loss of young fishes, but it will diminish it. Moreover, a limit to the time the trawl is down might be considered. The pressure of the larger on the smaller fishes when the bag of the net is hoisted by the derrick, and the swinging of the heavily-laden bag on the side of the ship in rough weather, however, are elements of disaster apparently beyond control at present. If the bag of the net with its fishes could be lifted horizontally into a raft or other apparatus level with the water, much injury to the contents, both young and adult, would be avoided; but the practical difficulties are great. In the other modes of fishing in which young fishes are captured in great numbers, and where restrictive measures are inapplicable, the obstacles would seem to be best met by the modification of apparatus and by the trained intelligence of the master-fisherman.

The question as to what constitutes an immature fish has not hitherto, perhaps, received that strict attention which it merits. In the trawling investigations of 1884 the term "immature" was not used in the strictly scientific sense—that is, in connection with the reproductive organs, though these were examined in all the species. The term, indeed, was purposely employed as nearly synonymous with unsaleable. Recently, Dr. Fulton, the energetic Scientific Secretary to the Fishery Board for Scotland, has had a large number of fishes examined—chiefly by Mr. T. Scott, on board the *Garland*—their sizes and the condition of the reproductive organs carefully noted, and the results, as elaborated by him, are given in a paper about to be issued by the Fishery Board in their Blue-book for 1890.[1] The paper is one of very great interest, and there can be little doubt that the term "immature" ought to be restricted to fishes that have never spawned; and it may thus happen that such may be saleable, *e.g.* in the case of the plaice, brill, turbot, cod, and others. On the other hand, mature food-fishes may be unsaleable from their small size, as in the case of the flounder, dab, and long rough dab, though, as already mentioned, these are important as the food of some of our most valuable fishes. As given by Dr. Fulton the smallest ripe food-fishes procured in the *Garland's* trawl were as follows:—Plaice 12 inches, lemon-dab 8 inches, dab 6 inches, long rough dab 6 inches, flounder 7 inches, craig-fluke (witch) 14 inches, turbot 18 inches, brill 16 inches, sail-fluke 9 inches, haddock 10 inches, whiting 8 inches, cod 20 inches, gurnard 8 inches, and catfish

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[1] This appears to differ from the results of the *Garland's* recent work.

[1] I have to thank Dr. Fulton for an early proof, issued, by the sanction of the Secretary for Scotland and the Fishery Board, in connection with the International Conference.

(*Anarrhichas*) 20 inches (?). In most cases these small specimens were males, as in the even more remarkable case of the salmon—in which the milt of a parr a few inches long can be utilized for the successful fertilization of the ova of an adult female salmon. There would therefore be grounds for saying that fishes of a less size than the foregoing are immature. From these observations it will be seen that the minimum size of 12 inches for turbot and brill—adopted by the representatives of the sea-fishing industry of the United Kingdom in June of this year—does not err on the side of excess. Further, since the mature males are often so much smaller than the females, it is apparent that the same restrictive size would not be practicable, though the numbers of the mature females are of greater importance for the welfare of the fisheries than those of the males.

While, therefore, many difficulties beset legislative measures for the preservation of the young fishes, there need be no halt in the efforts of the fishery authorities in investigating the deep-sea fishing grounds far from shore; and this should be carried out as far as practicable and as frequently as possible every month of the year. A comparison of the surface, mid-water, and bottom fauna there with that already known to exist in such bays as St. Andrews could not fail to give valuable and interesting data. Besides, the gaps in the life-histories of the post-larval and young stages of many fishes would thus be more or less bridged over. Finally, there can be little doubt of the expediency of at once providing suitable open-air tanks, *e.g.* at St. Andrews, in communication with the tidal water for the study of the post-larval and young stages of food-fishes, especially with regard to their rate of growth. It has yet to be proved also whether it would be best to place the larvæ of valuable fishes, such as turbot, brill, and soles, in the sea, or to keep them till the post-larval or young stages are reached. W. C. MCINTOSH.

ESTABLISHMENT OF SCIENCE SCHOLARSHIPS.

WE have already called attention to the science scholarships which are being established by the Commissioners for the Exhibition of 1851. The official statement on the subject is as follows:—

In their seventh report to the Crown, presented in July 1889, the Commissioners for the Exhibition of 1851 announced their intention of appropriating an annual sum of not less than £5000 a year to the establishment of scholarships, to enable the most promising students in provincial colleges of science to complete their studies either in those colleges or in the larger institutions of the metropolis, care being taken that these scholarships should be a supplement to, and not in competition with, scholarships already existing through either public action or private endowment.

The decision to restrict the scheme of scholarships to provincial colleges was due to the feeling of the Commissioners that the provinces, which took so large a part in supporting the Great Exhibition of 1851, had a just claim to receive as direct a benefit from the funds derived from that Exhibition as is afforded to the institutions on the Commissioners' Estate at South Kensington, which, although unquestionably of national importance, confer a more immediate advantage on the metropolis.

To assist them in preparing a scheme for the distribution and regulation of the scholarships' the Commissioners obtained the services of a committee of eminent men of science—namely, Prof. Garnett, Prof. Huxley, Prof. Norman Lockyer, Sir Henry Roscoe, and Sir William Thomson. To these were added two Commissioners, Mr. Mundella and Sir Lyon Playfair, the latter of whom acted as chairman of the committee.

On the 18th of June last this committee presented the accompanying report on the scope and objects of the scholarships, and it has been adopted by the Commissioners.

The committee then considered the manner in which the scholarships should be distributed. On this point they were bound by the restriction of the present scheme to students in provincial institutions, in which term, however, they suggested that colonial Universities might be comprised. They thought it unnecessary to include in the scheme the Universities of Oxford, Cambridge, and Dublin, in view of the large endowments of those bodies. The committee decided upon the allotment of an annual series of seventeen scholarships in the manner shown by the accompanying list, and the institutions named in the list will be invited to nominate scholars, subject to the conditions laid down in the report of the committee, and provided that they possess scholars worthy of the purposes explained in it.

The present allotment is to be considered experimental and temporary, and the selection now made of institutions to which nominations are offered will be subject to modification in the future, having regard not only to the manner in which the nominations are exercised, but also to the claims of other Universities and colleges which may from time to time be brought under the consideration of the Commissioners.

Provincial and Colonial Universities and Colleges.

Scholarships Annually.		
	1	University of Edinburgh.
	1	University of Glasgow.
Alternately .	1	University of St. Andrews (including University College, Dundee). University of Aberdeen.
	1	Mason College of Science, Birmingham.
	1	Bristol University College.
	1	Durham College of Science, Newcastle.
	1	Yorkshire College of Science, Leeds.
	1	Liverpool University College.
	1	Owens College, Manchester.
	1	Nottingham University College.
	1	Firth College, Sheffield.
Alternately .	1	Aberystwith (University College of Wales). Bangor (University College of North Wales). Cardiff (University College of South Wales).
In each year	2	Belfast, Queen's College. Cork, Queen's College. Galway, Queen's College. Dublin, Royal College of Science.
		Canada:—
Alternately .	1	M'Gill College, Montreal. University of Toronto.
		Australia:—
In each year	2	University of Sydney. University of Melbourne. University of Adelaide. University of New Zealand.
	17	

The following is the first report of the committee for considering the regulation and distribution of the science scholarships:—

The committee have had their attention drawn to the fact that there is a large number of scholarships in the country; that they are increasing at a rapid rate; and, if the Commissioners act on the same lines as those already occupied, it is possible that education will gain little by their action, as the endowment of the Commissioners may interfere with the establishment of new scholarships by private liberality.

Hence it is desirable that the scholarships with which this committee have to deal should be of a higher order than most of those now existing; in fact, their functions should begin where the ordinary educational curriculum ends. This system has been adopted with excellent effects by the French *École pratique des hautes études*.

The committee propose:—(1) That the scholarships shall be of £150 a year in value, and shall be tenable for two years, but in rare instances may be extended to three years by special resolution of the Commissioners. The continuation, each year after the first, shall depend upon the work done in the previous year being satisfactory to the scientific committee which it is suggested shall be appointed by the Commissioners.

(2) That the scholarships shall be limited to those branches of science (such as physics, mechanics, and chemistry) the extension of which is specially important for our national industries.

(3) That the Commissioners shall from time to time select a certain number of provincial and colonial colleges in which special attention is given to scientific education, and give to each